AIM-TRU Facilitation Guide

Welcome to *Analyzing Instruction in Mathematics using the Teaching for Robust Understanding (TRU) framework*, or AIM-TRU. This guide supports AIM-TRU facilitators who lead collaborative investigations of video cases based on Formative Assessment Lessons (FALs) found in the MfA Video Case Library.

The AIM-TRU cycle:

Materials List for Each AIM-TRU cycle

For each participant:
- ☐ Chosen lesson (pg. 2)
- ☐ Mathematical Context from lesson (pg. 6)
- ☐ Video Supplement from lesson (pg. 8)

For first session only
- ☐ Index cards (pg. 3)
- ☐ Chart Paper (pg. 3)

For each group during the mathematical context:
- ☐ Copies of the Mathematical Context materials, cut-up if necessary (pg. 7)

NOTE: group sizes vary depending on the task.

For each group of 4 during the video discussion:
- ☐ Discussion diamonds with a discussion question in the center (pg. 8)

For the whole group:
- ☐ Chart Paper with Norms (pg. 3)
- ☐ 6 x Chart paper for each mathematical big picture question (pg. 6)
- ☐ Extra Chart paper for facilitators to pull whole group answers
- ☐ Access to a projector and sound for the video you chose (pg. 2)

I. Homework before every meeting

FALs have detailed plans that take about 30 minutes to read. Since the video cases show brief episodes, it is important for all participants to have a good sense of where those episodes fit within the overall lesson context. For this reason the facilitator should ask all participants to read the selected lesson plan in its entirety before the meeting.

Asking participants to do 30 minutes of homework before a meeting is a big ask! You might explain that discussions during the meeting will be much more productive if all participants are familiar with the lesson. Reading the lesson plan will also help participants to become more familiar with the typical FAL format. Finally, after reading the plan all participants will know more about a great lesson they can potentially use with their students.

Figure 1. Screenshot from MfA video case library

Choosing an FAL video case

You can see all the cases in the MfA Video Case Library by going to the Teaching and Learning Exploratory website at the University of Michigan: https://tle.soe.umich.edu/mfa.

If this is your first visit to the site, you will need to create a free account to view the library.

You should choose video cases for your meetings that that align to the learning goals for participants. If participants you are completely new to FALs, we have found that the lesson "Representing Conditional Probabilities 1" FAL is a good introduction to that illustrates the kind of rich mathematical activity and interesting implementation challenged posed by FALs.

Other selection criteria might include the lesson topic, mathematical standards, or the type of activity in the lesson (whole class discussion or small group work, for example).

Preparing Materials for Participants

Once you have chosen a video case, you should:

- ☐ Email or print and give a copy of the associated lesson to all of your participants, preferably the week before to give time to read before the lesson. A PDF link to the lesson plan is included on the page for each video case in the library.
- ☐ Print a copy of the Mathematical Context document and Video Supplement document associated with the selected video case for each participant. A PDF link to these documents is included on the page for each video case in the library.
- ☐ Make adequate copies of the task to work through. Note that you may need to cut these out, depending on the task.

II. At the first meeting only

Getting the most out of video case discussions requires trust among participants and a willingness to respectfully critique one another's ideas in a safe space. To create this environment, we strongly recommend facilitators start with an opening activity that leads to a set of group norms that all participants can agree to. Experienced facilitators may prefer to use their own method to set norms. We have found the following activity works well, which is adapted from The Power of Protocols.

a. All: Set group norms using "Fears and Hopes" opening activity

1. Hand out index cards and ask participants to write down their greatest fear about the AIM-TRU meetings. Ask: "If this is the worst professional development you've ever experienced, what will or will not have happened." Don't worry about starting on a negative note – this activity paves the way for positive outcomes!
2. Ask participants to share what they wrote. Write what participants say exactly as they say it in a public place such as a white board. If multiple participants have the same fear, acknowledge this but do not write the same fear multiple times.
3. After all fears are listed, as participants to write down their greatest hope for the AIM-TRU meetings. Ask: "If this is the best professional development you've ever experienced, what will have happened?"
4. Record hopes in a public place using the same procedure as in step 2.
5. Say: "now we will make a list of group norms that should help us realize our hopes and assuage (or at least work through) our fears." When participants suggest a norm, such as "make sure no one person dominates the conversation," or "assume good intent when critiquing others ideas," take a moment to make sure the whole group agrees the norm. The norms can be debated and adjusted until you have a decent list that the group is mostly satisfied with. Write the final norms on a chart paper.
6. Explain to the group that the norms are a living document and can be adjusted as the meetings go on. Make sure to keep the chart paper with the norms and post them in the room for each session.

b. All: Give brief overview presentation on FALs and the TRU Framework

FALs are different from typical lessons that participants may be familiar with. In the first session, give participants a brief overview of how FALs work, what they are intended to accomplish, and the research they are based on.

Facilitators can include the information below on a custom slide or handout they create. Or you can use the AIM-TRU Slide Deck for facilitators (coming soon!).

Formative Assessment Lessons (FALs):

- The lessons are designed to help you assess your students' understanding of important mathematical ideas and practices in the Common Core State Standards
- Created by a research collaboration called the Math Assessment Resource Service (MARS). Development led by a team at the Shell Center for Mathematical Education
- Official name for FALs is *Classroom Challenges*. Nobody calls them that – often known as "FALs" "MARS Lessons" or "Shell Lessons."
- There are 100 lessons in all, covering topics in math grades 6 – 12. All lessons are here: https://www.map.mathshell.org/lessons.php

- The MARS site also contains a set of tasks. MARS lessons and MARS tasks are NOT the same resource.
- There are two types of FAL: Concept Development and Problem Solving. The lesson plans specify the type of lesson. Neither type of lesson is designed to introduce new content to students; they both help you understand where students are and help think more deeply about what they've learned.
    - Concept Development lessons are designed to assess what students know about particular content they have already been taught. Can be used 2/3 of the way through a unit or as review.
    - Problem Solving lessons can be used throughout the year to build students' facility in the Mathematical Practices from the Common Core State Standards.
- FALS designed to put as much of the weight of thinking on students as possible, by encouraging mathematical language, asking students to confront difficulties rather than avoid them, and using collaborative tasks
- FALs take about 90 minutes to implement. They can be spread over multiple class periods.
- Each FAL requires a pre and post assessment activity that takes about 20 minutes and can be done in or out of class.
- Planning and teaching FALs takes a lot of effort and time. Research has shown there is a big payoff for student learning, however. One rigorous study concluded that algebra teachers who used the lessons once a month for a year produced the equivalent of 4.6 months additional learning for their students!

FALs are created to support teaching that is aligned to the Teaching for Robust Understanding (TRU) Framework. TRU is a research-based, empirically validated framework that specifies five dimensions of classroom activity that are necessary and sufficient to produce students who are powerful mathematical thinkers. The five dimensions are summarized in the table below (from https://www.map.mathshell.org/trumath/tru_cg_math_2016_final.pdf)

The Five Dimensions of Mathematically Powerful Classrooms	
The Mathematics	How do mathematical ideas from this unit/course develop in this lesson/lesson sequence? How can we create more meaningful connections?
Cognitive Demand	What opportunities do students have to make their own sense of mathematical ideas? To work through authentic challenges? How can we create more opportunities?
Equitable Access to Content	Who does and does not participate in the mathematical work of the class, and how? How can we create more opportunities for each student to participate meaningfully?
Agency, Ownership, and Identity	What opportunities do students have to see themselves and each other as powerful mathematical thinkers? How can we create more of these opportunities?
Formative Assessment	What do we know about each student's current mathematical thinking? How can we build on it?

Figure 2. Dimensions of Teaching for Robust Understanding Framework

The research says that if each of these dimensions are present at high-levels in a lesson, then students are learning in powerful ways. If any of the dimensions are absent, then they are not. FALs are designed to support each dimension of the TRU Framework.

III. Every meeting: Investigate the mathematics in the lesson

Mathematical ideas and practices are central to the TRU Framework and FALs. Each AIM-TRU session dedicates a substantial portion of the meeting to collaboratively investigating the mathematics at the heart of the lesson.

a. All: Build a mathematical "big picture" for the lesson

The goal for a particular FAL is to help teachers assess how their students understand specific mathematical ideas. During the lesson, teachers have to make decisions about what moves to make and what questions to ask that appropriately push students to think more deeply about these ideas.

The choices teachers make about how to push students depend on what teachers want students to understand about the relevant mathematical objects, principles, patterns, and relationships, as well as their connection to other content in the curriculum. In short, teachers' choices about how to push students depend on a mathematical "big picture" that they want students to ultimately see.

This mathematical big picture is not, however, specified in any FAL lesson plan. It lives in the heads of teachers and is rarely made explicit in professional development. The first activity in AIM-TRU is to collectively specify the mathematical "big picture" framing the lesson in the video case.

1) Hand all participants copy of the Mathematical Context Document specific to the lesson that you chose (pg. 2 – this guide). Ask teachers to take out or hand out copies of the lesson that you are going to be investigating.

2) Ask someone to read the mathematical goals for the lesson. These are listed in the Mathematical Context Document exactly as they are in the lesson

3) Ask participants to read the four discussion questions found in the Mathematical Context that will be used to build the mathematical big picture. Give everyone four minutes to write silently about ONE of the questions (taken from the TRU Math Conversation Guide). Teachers can choose any question, as they all build towards the big mathematical picture:

    1. What do we want students to understand about the relevant mathematical objects in this lesson?
    2. What mathematical relationships, patterns, or principles do we want students to understand in this lesson?
    3. How might students connect math ideas in this lesson/unit with ideas that came before or will come later? Are there overarching principles or relationships or patterns that they might work toward understanding?
    4. What are different ways of representing the math in this lesson? How might different representations be connected to each other and how might these connections deepen our students' understanding?

4) Post four pieces of chart paper, one with each discussion question, around the room.

5) Ask participants to go to the chart paper for the question that they answered, where everyone at that chart paper is given the opportunity to share their thoughts. Only after everyone has spoken can they begin to write a consensus answer on the chart paper. It is okay if there are no people, or only one person at a piece of chart paper.

6) After an appropriate time, bring the chart papers together. Explain that the mathematical "big picture" is found in the sum total of all of these chart papers. After participants have looked across all four, ask what connections they see between them, and what conceptual understanding is built from this lesson. Record answers on another piece of chart paper, to refer to later.

b. All: Do the specific mathematical activity that will be shown in the video

The video that participants will watch in the video case shows mathematical activity taking place during an approximately five-minute episode during the lesson. To have the richest discussion possible, all participants should understand the intellectual demands of the mathematical activity at the deepest level possible by doing and discussing the math prior to watching the video.

The mathematical activity will require different materials for participants depending on which part of the lesson is featured in the video. If students are doing a card sort, for example, then participants will sort the same cards in small groups. If students worked a problem individually before discussing in small groups, participants will each need a copy of the problem to work on their own, before discussing in small groups. If students are asked to respond to a question in writing on mini-whiteboards, participants will need to respond to the same question on mini-whiteboards (or a substitute such as paper or index cards).

The Mathematical Context document explains the activity and contains everything you will need to do the mathematical activity with participants in the session. ***Depending on the activity, you may need to prepare in advance by making additional copies or gathering additional supplies such as mini-whiteboards or index cards.***

1) Explain to participants that they will do the same mathematical activity from the lesson plan that they will see students do in the video, and explain the directions, which are included in the Mathematical Context document.

2) Hand out materials that participants will need to do the mathematical activity. These materials (which you will need to have prepared in advance) that are included in the Mathematical Context document.

c. All: Discuss the specific mathematical activity that will be shown in the video

Now that everyone has experienced that mathematical activity that students will do in the video, discuss the mathematics as a group.

1) Locate the section of the Mathematical Context document called "Discussion Questions Focusing on the Mathematical Activity." Facilitate a whole-group discussion based on question #1 from this section.

d. All: Anticipate mathematical approaches and practices

After discussing question #1 from the section described above, continue the whole group discussion, now using discussion questions #2 & #3. It's important to put yourself in the math learner hat and have a complete discussion of all of the ways that the problem can be solved before moving on to imagining how it plays out in the classroom.

IV: Every meeting: Reflect on video from the lesson

After everyone has worked through the math, it is time to watch the video! This is usually the most exciting part of the AIM-TRU cycle – by observing rich student interactions, you will get to see students grapple with the mathematical concepts in the lesson and reflect on the instructional challenges encountered by the teacher.

Hand each participant a copy of the Video Supplement document.

a. Facilitator: Set group norms specific to watching video

The goal in watching the video is for participants to reflect on how the lesson played out in a real classroom, so that the participants can collectively come up with ideas for how they – the AIM-TRU participants themselves – can effectively implement this or similar FALs in their classrooms. The point is **NOT** to evaluate or judge the teacher who produced the video. To stick to this goal, the facilitator should ask participants to adhere to the following norms that are listed on the Video Supplement document.

- Speak from the "I" perspective. For example: "If I could rewind the tape and ask students a question, I would ask…"
- Be inquisitive, not judgmental. For example: "I wonder what might happen if," instead of "the teachers should have…"
- Justify your ideas and conjectures based on the video clip, and not other parts of the lesson that you didn't see. For example: "I think that the student understands...because in the video she…"
- Focus on how what you learned from the video might help you implement this (or similar lessons) with your own students.

After going over these norms, give participants a minute to look over the School Context, Lesson Context, and Video Context sections of the Video Supplement. This will give participants some added context for the video such as the type of school, grade, unit, and prior exposure to the topic for students in the video.

b. All: Watch a video episode from the lesson

Tell participants that you will now play the video from the lesson. Let them know that they will have access to a full transcript to support discussion after the video in the Video Supplement document. We recommend that participants watch the video without the aid of the transcript, since this better approximates what it is like to teach the lesson.

c. All: Reflect on the video episode from the lesson

i. Discussing student thinking and participation in the video episode[1]

1) Split participants into small groups of 3 or 4. Give each group a chart paper with a "diamond" (more precisely a rhombus) drawn using the midsections of each of the edges of the chart paper. Make sure that the first discussion question from the Video Supplement is written in the middle of each "Discussion Diamond."
2) Give each participant 3 minutes to write silently in one corner of the Discussion Diamond, giving their answer to the question in the middle.
3) Give each group 3 minutes to construct a consensus answer to the question, using the center of the "diamond."
4) Give each group one minute to share their answers, and then move to facilitate a whole-group conversation based on the question at the center of the diamond.

[1]The first two discussion questions in the Video Supplement are based on one dimension of TRU that was chosen by the design team and the teacher who was videotaped. Facilitators can choose a different dimension to focus on by substituting the first two questions in the Video Supplement for with those for another dimension, found on page 9.

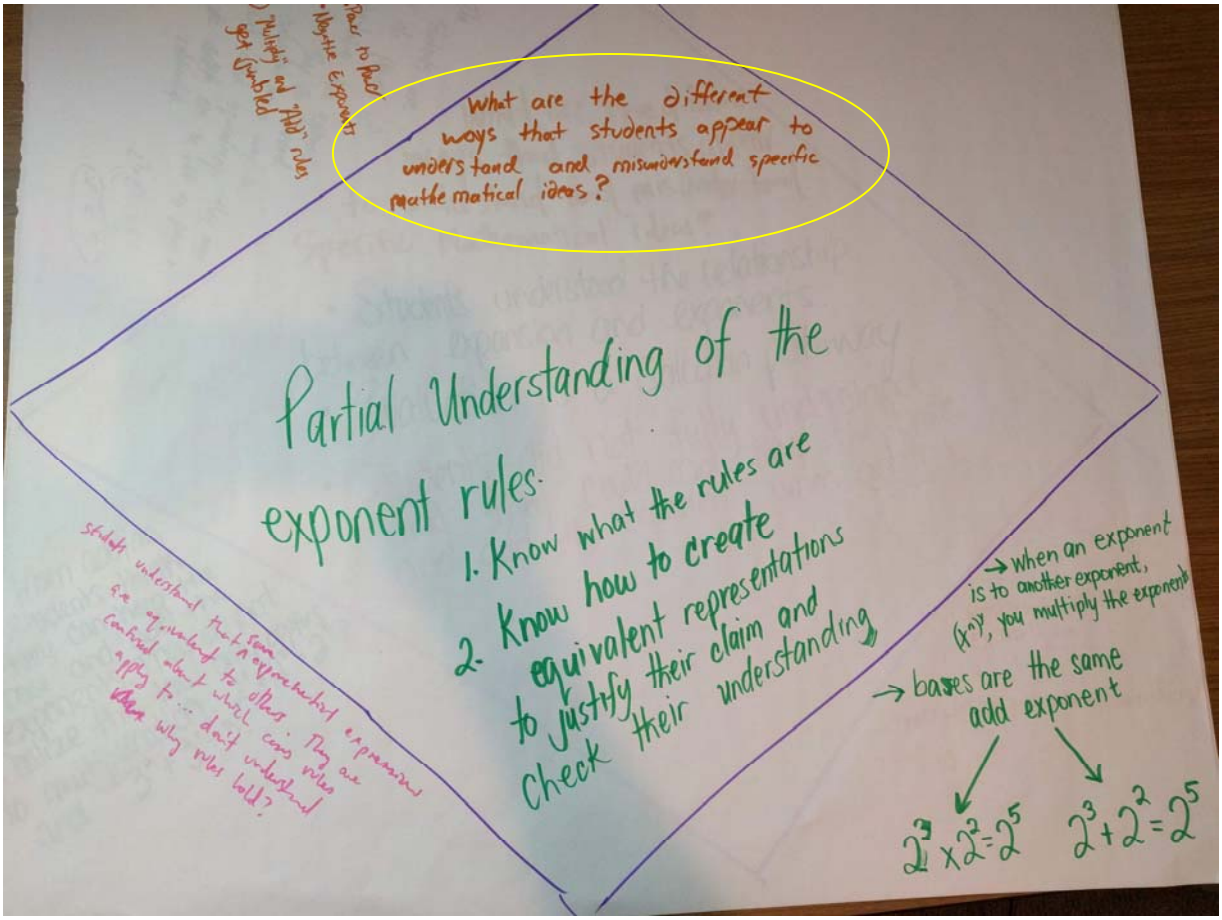

Figure 3. Sample Discussion Diamond. Note the Discussion Question circled in yellow and the group consensus answer underneath it

ii. Come up with teaching moves and questions that other teachers who try this lesson can use to help their students see the big mathematical picture more clearly

In this final step, participants imagine what teaching moves they might make or questions they might ask if they could go back in time and put themselves in the teacher of the lessons' place. The point of this exercise is to generate ideas for how teachers can push students to think more deeply about the mathematics in ways that help them see the big mathematical picture more clearly.

The facilitator should guide this open, whole group discussion based on the second and third questions in the Video Supplement, which should be projected or written in a public place.

Video Supplement Discussion Questions Based on TRU[2]:

Cognitive Demand: *How long am I given to think, and to make sense of things? What happens when I get stuck? Am I invited to explain things, or just give answers?*

1. What do students' explanations tell us about what they struggle with or finding challenging?
2. Imagine we could go back in time to this part of the lesson and put ourselves in the teacher's shoes. What questions might we ask or moves might we make that help students struggle more productively by inviting them to make sense of and explain things?
3. How might these questions or moves help illuminate the mathematical "big picture" we want students to understand related to this lesson/content?

Equitable Access to Mathematical Content: *Do I get to participate in meaningful mathem learning? Can I hide or be ignored?*

1. Who participates and how? Are any students ignored or "hidden" in the conversation?
2. Imagine we could go back in time to this part of the lesson and put ourselves in the teacher's shoes. What questions might we ask or moves might we make that encourage more meaningful participation by all students?
3. How might these questions or moves help illuminate the mathematical "big picture" we want students to understand related to this lesson/content?

Agency, Ownership, and Identity: *Do I get to explain, to present my ideas? Are they built on? Am I recognized as being capable and able to contribute in meaningful ways?*

1. How are students' ideas presented and built upon? How are students recognized as being capable and able to contribute in meaningful ways?
2. Imagine we could go back in time to this part of the lesson and put ourselves in the teacher's shoes. What questions might we ask or moves might we make that better build students' thinking and recognize them as being capable and able contributors?
3. How might these questions or moves help illuminate the mathematical "big picture" we want students to understand related to this lesson/content?

Formative Assessment: *Do classroom discussions include my thinking? Does instruction respond to my thinking and help me think more deeply?*

1. What do students appear to understand and misunderstand about specific mathematical ideas?
2. Imagine we could go back in time to this part of the lesson and put ourselves in the teacher's shoes. What questions might we ask or moves might we make that respond to students' thinking and help them to think more deeply about specific mathematical ideas?
3. How might these questions or moves help illuminate the mathematical "big picture" we want students to understand related to this lesson/content?

[2] TRU has five dimensions, including The Mathematics. The mathematics of the lesson is central to each AIM-TRU meeting and is discussed in depth during part III of the cycle.